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Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams EPA 841-B-06-002

Chapter 3 Wadeable Streams Assessment Ecoregion Results

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The WSA is designed to report on two geographic scales: a broader national scale and a finer ecoregional scale. Whereas Chapter 2 presented the national scale results, this chapter focuses on the results for nine ecological regions. Ecological regions are areas that contain similar environmental characteristics. Natural characteristics such as climate, vegetation, soil type and geology are used to create these regions. EPA has defined ecoregions at various scales ranging from coarse (Level I) ecoregions at the continental scale to fine (Levels III and IV) ecoregions that divide states into smaller ecosystem units. Ecoregions are designed to be used in environmental assessments, for setting water quality and biological criteria, and to set management goals for nonpoint source pollution.

The nine WSA ecoregions are aggregations of the Level III ecoregions delineated for the conterminous United States. For each of the WSA ecoregions, this chapter provides background information on physical setting, biological setting and human influence. It also describes the WSA results for the wadeable stream length throughout the region.

Results for an ecoregion may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales. Note that a number of states implement randomized designs at the state scale to characterize water quality throughout their state, but those characterizations are not described in this report.

The nine ecoregions encompass a variety of habitats and land-uses. The least-disturbed reference sites used to set benchmarks for good, fair, and poor condition reflect that variability. For some ecoregions, the variability among reference sites is very small, while it is larger in others. In a series of regional meetings, professional biologists examined the variability of reference sites and implications to the benchmarks used to characterize a region and to compare stream condition across regions. The benchmarks or thresholds were adjusted for those regions where there was a disturbance signal associated with the variability among reference sites. (Refer to Appendix A for more detail on the development of benchmarks or thresholds for each of the indicators.)

It should be noted that there are many specific and unique features within each ecoregion that are not fully captured in this report (see the References in Chapter 5 for more information). The nine ecoregions defined in this text are the following:

- Northern Appalachians (NAP)
- Southern Appalachians (SAP)
- Coastal Plains (CPL)
- Upper Midwest (UMW)
- Temperate Plains (TPL)
- Southern Plains (SPL)
- Northern Plains (NPL)

- Western Mountains (NMT)
- Xeric (XER)

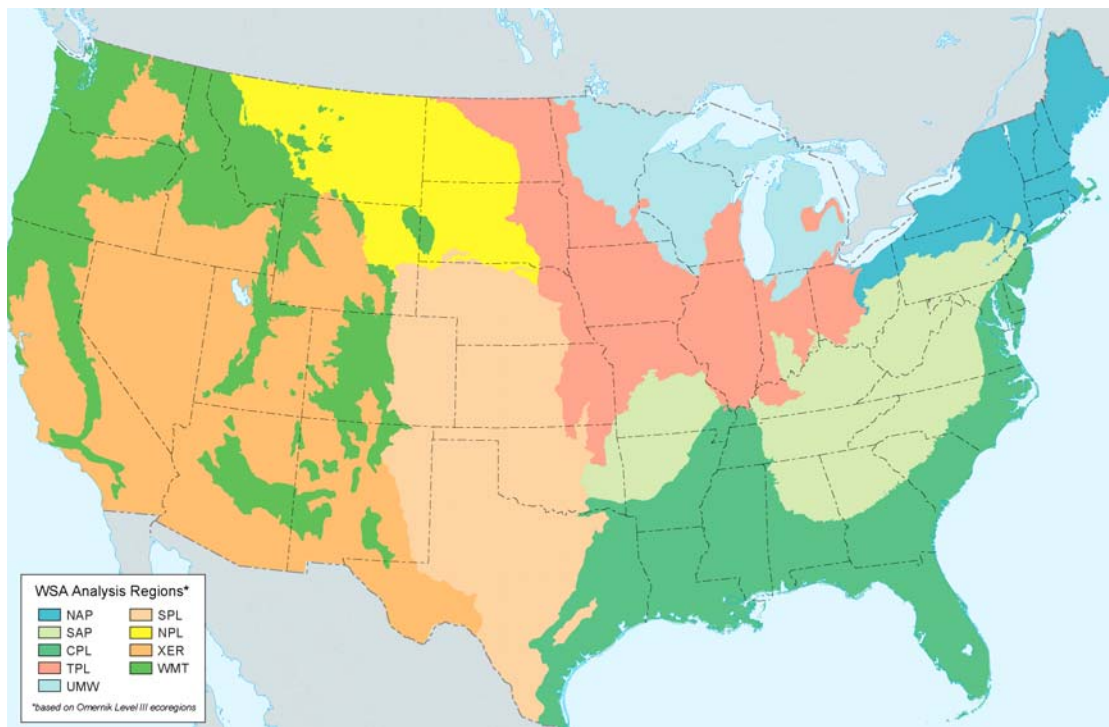


Figure 3-1. Ecological reporting regions for the Wadeable Streams Assessment.

Northern Appalachians Ecoregion

Physical Setting

The Northern Appalachians ecoregion covers all of the New England states, most of New York, the northern half of Pennsylvania, and northeast Ohio. It encompasses New York's Adirondack and Catskill mountains and Pennsylvania's mid-northern tier, including the Allegheny National Forest. Major river systems for this ecoregion are the St. Lawrence, Allegheny, Penobscot, the Connecticut, and the Hudson rivers. Major waterbodies include Lakes Ontario and Erie, New York's Finger Lakes, and Lake Champlain. There are 97,913 miles of wadeable streams in the Northern Appalachians that are represented by the WSA.

The topography is generally hilly with some intermixed plains and old mountain ranges. River channels in the glaciated uplands of the northern parts of this ecoregion have steep profiles and rocky beds and flow over glacial sediments. The climate is cold to temperate, with mean annual temperatures ranging from 39° to 48° F. Annual precipitation totals range from 35 to 60 inches. This ecoregion comprises some 139,424 mi² (4.6% of the United States), with about 4,722 mi² (3.4%) under federal ownership. Based on satellite images in the National Land Cover Dataset (1992), the distribution of land cover is 69% forested and 17% planted/cultivated, with the remaining 14% of land in other types of cover.

Biological Setting

Contemporary fish stocks are lower than at the time of European contact, but the coastal rivers of this ecoregion still have a wide variety of anadromous fish, including shad, alewife, salmon, and sturgeon.

Human Influence

Early European settlers in 17th century New England removed beaver dams, allowing floods to pass more quickly, flushing sediment and decreasing diversity and availability of riparian habitat. Forests were cleared to introduce crops and pasture for grazing animals. Deforestation efforts caused the removal of sediments and nutrients and reduced riparian habitat. Roughly 96% of the original virgin forests of the eastern and central states was gone by the 1920s.

Smaller tributaries were often disrupted through splash damming—a 19th century practice of creating dam ponds for collecting timber and then exploding the dams to move timber downstream with the resulting torrent of flood waters. This flushed sediment and wood downstream scoured many channels to bedrock. Streams that were not splash dammed currently have tens to hundreds of times more naturally occurring woody debris and deeper pools. During the 18th and early 19th centuries, streams with once-abundant runs of anadromous fish declined due to stream sedimentation, clogging from sawmill discharges, and the effects of dams. Increased human and animal waste from agricultural communities changed stream nutrient chemistry. When agriculture moved west and much of eastern farmland converted back into woodlands, sediment yields declined in some areas.

Today, major manufacturing, chemical, steel, and power production (e.g., coal, nuclear, oil) occur in the large metropolitan areas found around New York City and into the states of Connecticut and Massachusetts. Many toxic substances, including petroleum products, organochlorines, polychlorinated biphenyls (PCBs), and heavy metals, along with increased nutrients such as nitrates and phosphates, are the legacy of industrial development. There are currently 215 active, 6 proposed, and 45 deleted EPA Superfund National Priority List sites in this ecoregion.

It is also common for treated wastewater effluent to account for much of stream flow downstream from major urban areas in this ecoregion. Treated wastewater can be a major source of nitrate, ammonia, and phosphorus to streams, as well as heavy metals, volatile organic chemicals (VOCs), PCBs, and other toxic compounds.

This region also includes forestry, mining, fishing, and tourism. Agricultural activities include dairy cattle farming, potato production, poultry farming, timber harvesting, and wood processing of pulp, paper, and board.

The approximate population within the ecoregion is 40,550,000, which is about 14% of the total population of the United States.

Summary of WSA Findings

It should be noted that about 27% of the wadeable stream resource in the Northern Appalachians was not assessed. This is because small, 1st order streams were not included in the sample frame in New England because of a decision to match an earlier New England random

design. The numbers cited below apply to the 73% of wadeable streams in the ecoregion that were assessed.

A total of 85 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales. In a series of WSA regional workshops to evaluate the results, professional biologists expressed the view that many of the least-disturbed reference sites are nearly undisturbed streams with sparse human population in the immediate watershed. Therefore, the reference condition in the Northern Appalachians is of very high quality. An overview of the WSA survey results for the Northern Appalachian ecoregion is shown in Figure 3-2.

Biological Condition

- The findings of the Macroinvertebrate Index are that 45% of the stream length in this ecoregion is in poor condition, 15% is in intermediate or fair condition, and 13% is in good condition when compared to the least-disturbed reference condition. As noted above, 1st order streams, generally considered to be of high quality in this region, were not included in the assessment.
- O/E taxa loss results find that 50% of the stream length in the ecoregion has lost more than 10% of the macroinvertebrate taxa that are expected to occur, and 19% has lost 50% or more of its taxa. This indicator tells us that 23% of stream miles have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

Indicators of Stress

Leading indicators of stress in the Northern Appalachians include total phosphorus, total nitrogen, streambed sediments, and riparian vegetative cover.

- About 45% of the total stream length in the ecoregion has high phosphorus levels compared to the relatively low levels found at reference sites, 16% has medium levels, and 12% has low levels.
- Similarly, about 45% of total stream length has high nitrogen levels, 10% has medium levels, and 18% has low levels compared to reference.
- Riparian disturbance evidence of human influence in the riparian zone is at high levels in 20% of the total stream miles, medium levels in 34%, and at low levels in 19% of stream miles.
- Salinity is found at high levels in 1%, at medium levels in 8%, and at low levels in 64% of stream miles.
- Analysis of physical stressors reveals that 29% of the total stream miles in the ecoregion are rated poor because of excess streambed sediments, 14% are in fair condition, and 28% in good condition compared to reference.
- For in-stream fish habitat, 16% of stream length is in poor condition, 13% is in fair condition, and 44% is in good condition compared to reference.

- Vegetative cover in the riparian zone along stream banks is in poor condition for 26% of the stream length, fair for 27%, and good for 20%.
- Acidification primarily associated with acid rain was detected in 3% of the total stream miles in the ecoregion.

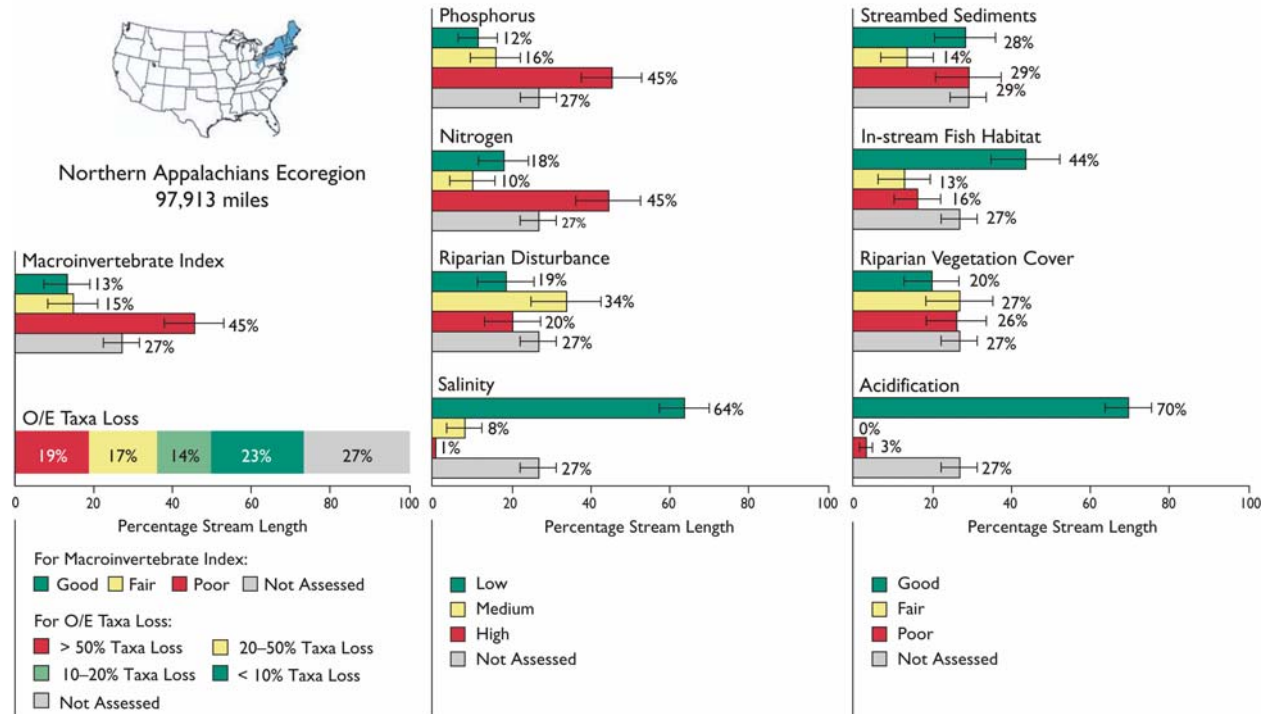


Figure 3-2. WSA survey results for the Northern Appalachians ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Southern Appalachians Ecoregion

Physical Setting

The Southern Appalachians ecoregion stretches over 10 states, from northeastern Alabama to central Pennsylvania. Also included in this region are the interior highlands of the Ozark Plateau and the Ouachita Mountains in Arkansas, Missouri, and Oklahoma.

The region covers about 321,900 mi² (10.7% of the United States) with about 42,210 mi² (10.7%) under federal ownership. Many significant public lands, such as the Great Smoky Mountains National Park and surrounding national forests, the George Washington and Monongahela National Forests, and the Shenandoah National Park, reside within the region. Topography is mostly hills and low mountains with some wide valleys and irregular plains. Piedmont areas are included within the Southern Appalachians ecoregion.

Rivers in this ecoregion flow mostly over bedrock and other resistant rock types, with steep channels and short meander lengths. Major rivers such as the Susquehanna, James, and Potomac — along with feeders into the Ohio-Mississippi systems such as the Greenbrier River in

West Virginia — originate in this region. There are 178,449 wadeable stream miles represented by the WSA for the Southern Appalachians Region.

The area's climate is considered temperate wet. Precipitation totals for the year average 40 to 80 inches. Mean annual temperature ranges from 55° to 65° F. Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 68% forested and 25% planted/cultivated, with the remaining 7% of land in other types of cover.

Biological Setting

The region has some of the highest aquatic animal diversity of any area in North America, especially for species of amphibians, fishes, mollusks, aquatic insects, and crayfishes. Salamanders, plants, and fungi reach their highest North American diversity in the southern Appalachians; however, some 18% of animal and plant species in the region are threatened or endangered.

Some areas in the Southern Appalachians, such as the spruce-fir forests in the southern part of the region, are among the least impacted pre-settlement vegetative cover in the United States. The Great Smoky Mountains National Park and other national forests continue to protect exceptional stands of old growth forest riparian ecosystems.

Human Influence

The effects of habitat fragmentation, urbanization, agriculture, channelization, diversion, and impoundments on river systems have altered a large amount of the stream length in the Southern Appalachians region. Placer mining began in the Appalachians in the 1820s. Placer mining disrupts stream beds and increases a stream's ability to transport finer sediments that disrupt habitat and water quality downstream. Between 1930 and 1971, some 800 mi² were surface mined in the Appalachian Highlands, leading to acidification of streams and reduction of aquatic diversity. Placer mining and surface mining operations have introduced many toxic contaminants to river systems in the Southern Appalachians. Toxic contaminants from mining include arsenic, antimony, copper, chromium, cadmium, nickel, lead, selenium, silver, and zinc. There are 224 active, 5 proposed, and 46 deleted EPA Superfund National Priority List sites in this ecoregion.

Economic activities in the Southern Appalachians ecoregion include forestry, coal mining, and some local agriculture and tourism. Petroleum and natural gas extraction are prevalent along the coal belt. Besides coal, other mining activities found in this ecoregion are bauxite, zinc, copper, and chromium mines. Utility industries include hydro-power in the Tennessee Valley and numerous coal-fired plants throughout the region. Significant agricultural activities are alfalfa production in Pennsylvania, with apple and cattle production throughout the region. Wood processing, pulp, paper, and board production are prevalent across the region.

Approximately 50,208,000 people live in the Southern Appalachians ecoregion, which is about 17% of the total population of the United States.

Summary of WSA Findings

A total of 184 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not

intended to characterize stream conditions at these finer scales. In a series of WSA regional workshops to evaluate the results, professional biologists expressed the view that the least-disturbed reference streams in the Southern Appalachians represent varying degrees of human influence. Although some streams are in remote areas, others are intricately linked with road systems in narrow floodplains. An overview of the WSA survey results for the Southern Appalachians ecoregion is shown in Figure 3-3.

Biological Condition

- The Macroinvertebrate Index tells us that 55% of the stream length in the Southern Appalachians ecoregion is in poor condition, 24% is in fair or intermediate condition, and 21% is in good condition compared to reference.
- The O/E taxa loss results find that 65% of the stream resource in the region has lost more than 10% of the macroinvertebrate taxa that are expected to occur, and 16% has lost 50% or more of its taxa. This indicator tells us that 30% of stream miles have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference conditions.

Indicators of Stress

Leading indicators of stress in the Southern Appalachians ecoregion include total nitrogen, total phosphorus, riparian disturbance, and streambed sediments.

- Phosphorus levels are high in 41% of stream miles, medium in 15%, and low in 44% when compared to least-disturbed reference condition.
- About 41% of wadeable stream miles in the region have high levels of nitrogen, 20% have medium levels, and 39% have low levels.
- Riparian disturbance is at high levels for 33% of stream miles, at medium levels for 44%. This evidence of human influence in the riparian zone is low for 23% of stream miles throughout the ecoregion.
- Only 2% of stream miles have high levels of salinity, 11% have medium levels, and the remaining 87% have low levels compared to reference condition.
- Streambed sediments are in poor condition in 27% of the stream length and in fair condition in 32% compared to least-disturbed reference condition. About 41% of stream miles are in good condition.
- In-stream fish habitat is in poor condition in 4% of stream miles, in intermediate or fair condition in 34% of stream miles, and in good condition in 62% of stream miles.
- Vegetative cover in the riparian zone along stream banks is in poor condition in 13% of the stream length, fair in 33%, and good in 54%.
- Acidification is rated in poor condition in 3% of the stream miles in the region due to acidic deposition and acid mine drainage.

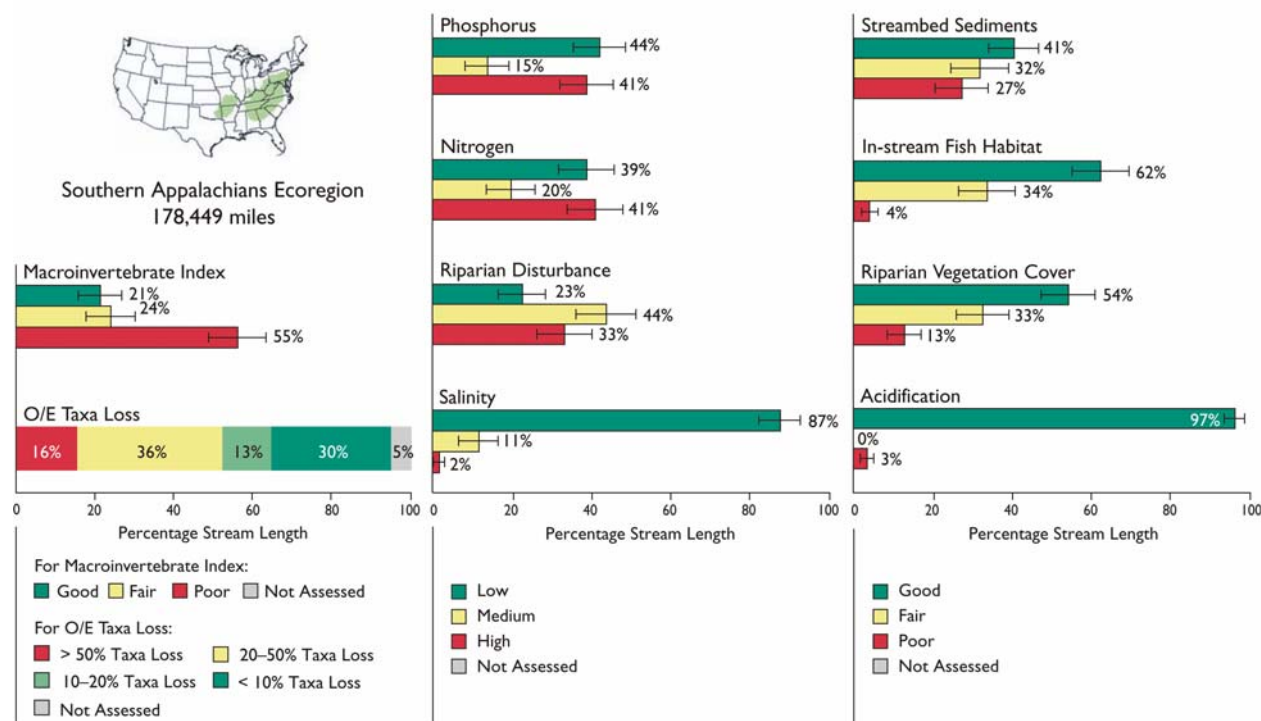


Figure 3-3. WSA survey results for the Southern Appalachians ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Coastal Plains Ecoregion

Physical Setting

The Coastal Plains ecoregion covers the Mississippi Delta and Gulf Coast, north along the Mississippi River to the Ohio River, all of Florida, eastern Texas, and the Atlantic seaboard from Florida to New Jersey. Total area is about 395,000 mi² (13% of the United States) with 25,890 mi² (6.6%) under federal ownership. River systems lying within or intersecting the Coastal Plains are the Mississippi, Suwanee, Savannah, Roanoke, Potomac, Delaware, Susquehanna, James, Sabine, Brazos, and Guadalupe rivers.

Rivers in the Coastal Plains meander broadly across flat plains created by thousands of years of river deposition and form complex wetland topographies with levees, backswamps, and oxbow lakes. Rivers typically drain densely vegetated catchment areas, whereas well-developed soils and less intensive rains and subsurface flows keep suspended sediment levels in the rivers relatively low. The Mississippi River carries large loads of sediments from dry lands in the central and western portion of the drainage. A total of 72,130 of wadeable stream miles in the Coastal Plains ecoregion are represented in the WSA.

The Coastal Plains ecoregion contains about one-third of all remaining U.S. wetlands, more than half of U.S. forested wetlands, and the largest aggregate area of U.S. riparian habitat. Topography of the area is mostly flat plains, barrier islands, numerous wetlands, and about 50

important estuarine systems that lie along the coastal margins. The climate is considered temperate wet to subtropical in the south, with average annual temperatures ranging from 50° to 80° F and annual precipitation ranging from 30 to 79 inches. Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 39% forested, 30% planted/cultivated, and 16% wetlands, with the remaining 15% of land in other types of cover.

Biological Setting

River habitats in the Coastal Plains ecoregion have tremendous species richness and the highest number of endemic species of aquatic organisms in North America. Abundant fish, crayfish, mollusk, and aquatic insect species include such unique species as paddlefish, catostomid suckers, American alligator, and giant aquatic salamanders. It is estimated, however, that some 18% of the aquatic species in this region are threatened or endangered. This ecoregion includes the Everglades, a unique ecosystem that contains temperate and tropical plant communities and a rich variety of species of birds and wildlife. However, because it is a unique aquatic ecosystem, the waters in the Everglades are not represented by the results of the WSA.

Human Influence

Historically, the Coastal Plains ecoregion had extensive bottomlands that flooded for several months, but are now widely channelized and confined by levees. Damming, impounding, and channelization in almost all major rivers have altered the rate and timing of water flow, as well as the productivity of riparian habitats. Pollution from acid mine drainage, urban runoff, air pollution, sedimentation, recreation, and the introduction of non-indigenous fishes and aquatic plants have also affected riparian habitats and aquatic fauna. There are currently 275 active, 13 proposed, and 77 deleted EPA Superfund National Priority List sites in this ecoregion.

The region's economy is varied and includes many activities. Agriculture includes citrus, peanut, sugar cane, tobacco, cattle, poultry, cotton, corn, rice, vegetable, and stone fruit production. Industries include pulp, paper and board, and board wood processing; aluminum production; salt, sulfur, bauxite, and phosphate mining; and chemical and plastics production. Approximately 40% of U.S. petrochemical refinery capacity is found in the Coastal Plains region, some of which is offshore in the Gulf of Mexico.

The region also includes many large coastal cities, which contribute to a population of approximately 56,168,000, the largest population of all the WSA ecoregions and about 19% of the population of the United States.

Summary of WSA Findings

A total of 83 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales. In a series of WSA regional workshops to evaluate the results, professional biologists expressed the view that the high prevalence of human population centers, agriculture, and industry makes it difficult to find truly undisturbed streams in the Coastal Plains ecoregion. Therefore, the least-disturbed reference sites in this ecoregion are influenced to some degree by human activities. An overview of the WSA survey results for the Coastal Plains ecoregion is shown in Figure 3-4.

Biological Condition

- The Macroinvertebrate Index reveals that 39% of the stream length in the Coastal Plains is in poor condition, 23% is in fair or intermediate condition, and 36% is in good condition compared to reference. No data are available for 2% of the resource.
- The O/E taxa loss indicator tells us that 65% of the stream length has lost 10% or more of the macroinvertebrate taxa that are expected to occur, and 15% has lost 50% of its taxa. This indicator tells us that 32% of stream miles have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference conditions.

Indicators of Stress

Leading indicators of stress in the Coastal Plains ecoregion include total phosphorus, in-stream fish habitat, riparian vegetative cover, and streambed sediments.

- Phosphorus is found at high levels in 29% of stream miles, at medium levels in 13%, and in low levels in 58% of stream miles compared to least-disturbed reference condition.
- Nitrogen is high in 10% of stream miles, medium in 18%, and low in 72%
- Riparian disturbance is at high levels for 20% of stream miles and, at medium levels in 50%. This evidence of human influence in the riparian zone is at low levels for 30% of the stream length.
- In about 5% of stream miles, salinity levels are rated as high or medium; the remaining 95% of stream miles have low levels compared to reference.
- Streambed sediments are rated poor in 22% of the stream miles, in fair condition in 11%, in good condition in 64% compared to least-disturbed reference conditions, and there is no data for the remaining 3%.
- In-stream fish habitat is poor in 41% of stream length in the Coastal Plains, fair in 13%, and good in 46%, as compared to reference.
- Vegetative cover in the riparian zone along stream banks is in poor condition in 24% of the stream resource, in fair condition in another 24%, and in good condition in the remaining 52%.
- In this region, 6% of stream miles are rated poor because their acid neutralizing capacity is low enough to result in episodic acidification during rainfall. Another 5% have naturally lower pH.

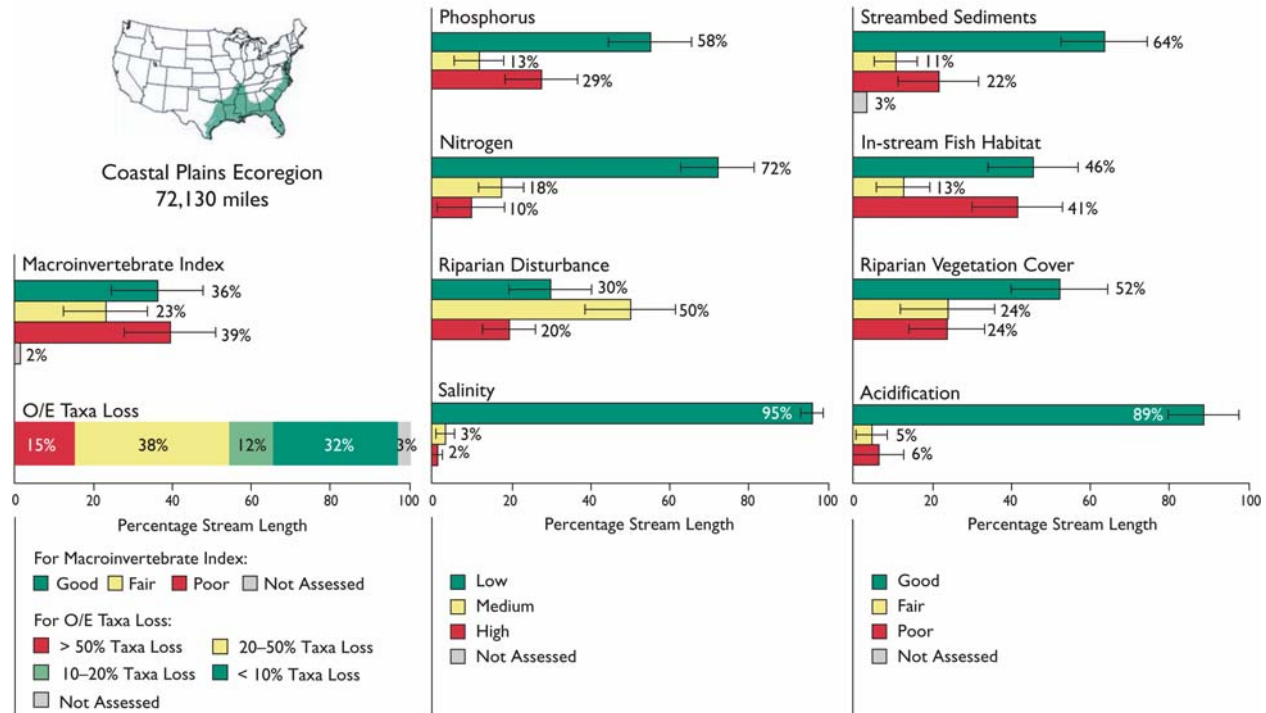


Figure 3-4. WSA survey results for the Coastal Plains ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Upper Midwest Ecoregion

Physical Setting

The Upper Midwest ecoregion covers most of the northern half and southeastern part of Minnesota, two-thirds of Wisconsin, and almost all of Michigan, extending about 160,374 mi² (5.4% of the United States). The river systems in this region empty into portions of the Great Lakes regional watershed and the Upper Mississippi watershed. Major river systems in this region include the upper Mississippi in Minnesota and Wisconsin; the Wisconsin, Chippewa, and St. Croix rivers in Wisconsin; and the Menominee and Escanaba rivers in Michigan. Streams typically drain relatively small catchments and empty directly into the Great Lakes or Upper Mississippi River. These streams tend to have steep gradients, but the topography and soils tend to slow runoff and sustain flow throughout the year.

A total of 36,547 wadeable stream miles in the Midwest ecoregion are represented in the WSA. Sandy soils dominate with relatively high water quality in streams supporting cold-water fish communities. Important water bodies include the Upper Mississippi River system and Lakes Superior, Michigan, Huron, and Erie. The climate is cool to temperate, with mean annual temperatures in the 40° to 54° range. Annual precipitation ranges from 28 to 47 inches.

The glaciated terrain of this ecoregion is typically plains with some hill formations. Numerous lakes, rivers, and wetlands predominate in most areas. The climate is characterized by cold winters and relatively short, warm summers, with mean annual temperatures ranging from

34° to 54° F and annual precipitation in the 20- to 47-inch range. Much of the land is covered by national and state forest. Federal lands account for 15.5% of the area at about 25,000 mi². Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 40% forested, 34% planted/cultivated, and 17% wetlands, with the remaining 9% of land in other types of cover.

Biological Setting

Vegetative cover is mixed boreal woodland, mixed oak-hickory associations, and conifers, as well as bog and moss barrens. The Great Lakes aquatic ecosystems are subject to increasing intrusion by invasive animal and plant species introduced by ocean shipping, like the zebra mussel, the round goby, the river ruffe, the spiny water flea, and Eurasian watermilfoil.

Human Influence

The Upper Great Lakes portion of the Upper Midwest ecoregion was entirely forested in pre-colonial times. Virtually all of the virgin forest was cleared in the 19th and early 20th centuries, and streams and rivers were greatly affected by the logging industry. The upper Mississippi River portion of the Upper Midwest ecoregion was also heavily influenced by logging and agriculture.

Major manufacturing, chemical, steel, and power production (e.g., coal, nuclear, oil) occur in the large metropolitan areas found in the Upper Midwest. Other key economic activities are forestry, mining, and tourism. Agriculture includes dairy production, grain crops in the western areas, fruit production around the Great Lakes, and hay and cattle farming throughout the region. Pulp, paper, and board wood processing are prevalent throughout the northern parts of the region. The area includes the shipping ports at Duluth, MN, and Superior, WI, as well as cities like Marquette, Michigan and Hibbing, MN, which were built up along with the mining industry. The Upper Peninsula of Michigan lies entirely within this region, as does Minnesota's Mesabi Range, the largest U.S. iron ore deposit. This area is subject to the environmental effects of mining operations. There are currently 112 active, 1 proposed, and 12 deleted EPA Superfund National Priority List sites in this ecoregion.

The approximate population of this area is 15,854,000, or about 5% of the population of the United States.

Summary of WSA Findings

A total of 56 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales. In a series of WSA regional workshops to evaluate the WSA results, professional biologists expressed the view that the least-disturbed streams that serve as a benchmark for reference condition in the Upper Midwest are mostly influenced by some form of human activity or land use. However, there are some streams in relatively undisturbed areas, particularly in the northern portion of the region. An overview of the WSA survey results for the Upper Midwest ecoregion is shown in Figure 3-5.

Biological Condition

- The Macroinvertebrate Index reveals that 39% of stream length in the Upper Midwest ecoregion is in poor condition, 31% is in fair condition, and 28% is in good condition compared to least-disturbed reference condition.
- The O/E taxa loss indicator tells us that 54% of stream miles have lost 10% or more of macroinvertebrate taxa that are expected to occur, and 5% have lost 50% of taxa. This indicator reports that 45% of stream miles have retained at least 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

Indicators of Stress

Leading indicators of stress in the Upper Midwest ecoregion include total phosphorus, total nitrogen, streambed sediments, and in-stream fish habitat.

- Phosphorus levels are high in 38% of stream miles, at medium levels in 18%, and at low levels in 42% compared to thresholds based on the least-disturbed reference condition for the region.
- Nitrogen is high in 21% of the stream length and medium in 30% of the stream length; in the remaining 48% of stream length, nitrogen is at low levels compared to least-disturbed reference condition.
- Riparian disturbance levels are high in 6% of stream miles and medium in 45%. This evidence of human influence in the riparian zone is low for 49%.
- Salinity is found at medium levels in 22% of stream miles.
- Fifty percent of stream miles are rated poor for excessive streambed sediments, 11% are rated fair, and 37% are rated good compared to least-disturbed reference condition. (There is no data on this stressor for 2% of the stream resource.)
- In-stream fish habitat is in poor condition in 17% of stream miles and fair condition in 69%, leaving 14% in good condition compared to reference.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 13% of stream length, fair condition for 38%, and in good condition for 44% of stream length.
- The effects of acidification are not noted in streams in this ecoregion.





Figure 3-5. WSA survey results for the Upper Midwest ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Temperate Plains Ecoregion

Physical Setting

The Temperate Plains ecoregion includes the open farmlands of Iowa, the eastern Dakotas, western Minnesota; portions of Missouri, Kansas, and Nebraska; and the flat farmlands of western Ohio, central Indiana, Illinois, and southeastern Wisconsin. This ecoregion covers some 342,200 mi² (11.4% of the United States), with approximately 7,900 mi² (2.3%) in federal ownership. The terrain consists of smooth plains, numerous small lakes, and wetlands. The climate is temperate, with fairly cold winters and hot, humid summers; mean temperatures range from 36° to 55° F. Precipitation ranges from 16 to 43 inches annually.

Many of the rivers in the region drain into the Upper Mississippi and Ohio regional watersheds. There are also a few systems that empty into the Great Lakes watershed near Toledo, OH; Saginaw, MI; Detroit, MI; and southeastern Wisconsin. Rivers are either supplied by snowmelt or groundwater. Rivers in the tall grass prairie start from prairie potholes and springs and are likely to be ephemeral, flowing for a short time after snowmelt or rainfall. The prairie rivers carry large volumes of fine sediments, and tend to be turbid, wide, and shallow. A total of 100,879 wadeable stream miles in the Temperate Plains ecoregion are represented in the WSA. Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 9% forested and 76% planted/cultivated, with the remaining 15% of land in other types of cover.

Biological Setting

Vegetation of the area consists primarily of oak, hickory, elm, ash, beech, and maple, with increasing amounts of prairie to the west. Rivers have rich fish fauna with many species, including minnows, darters, killifishes, catfishes, suckers, sunfishes, and black basses. Few species are endemic to the region, but have adapted to the warm, shallow creek environments.

Human Influence

Pre-settlement vegetation of the area was prairie grass and aspen parkland, but it is now about 75% arable cultivated lands. This ecoregion is rich in agricultural production, including field crops such as corn, wheat, alfalfa, soybeans, flaxseed, and rye, along with vegetable crops such as peanuts and tomatoes. Hog and cattle production and processing are prevalent. Crops and grazing have reduced natural riparian vegetation cover, increased sediment yield, and introduced pesticides and herbicides into the watershed. Conservation tillage — a reduced-cultivation method — has been implemented in about 50% of crop fields in the Maumee River Basin and in northwestern Ohio tributaries draining to Lake Erie. USGS NAWQA findings from 1993–1998 in these rivers showed significant decreases in the amounts of suspended sediment. Rivers in the Temperate Plains ecoregion also tend to have high nitrogen levels due to nutrients from agriculture and from fertilizer in urban areas applied to lawns and golf courses. In Illinois, where land is intensively developed through urbanization and agriculture, more than 25% of all sizable streams have been channelized, and almost every stream in the state has at least one dam.

Coal mining, petroleum and natural gas production, and zinc and lead mining occur across the region. There are very active areas of manufacturing, steel production, and chemical production in the region's urban centers, with especially high concentrations near Detroit, MI, and the industrial belt from Gary, IN, to Chicago, IL, and Milwaukee, WI. Industrial activities in these large urban centers have contributed sewage, toxic compounds, and silt to river systems. Heavy metals, organochlorines, and PCBs are especially prevalent and persistent river contaminants found in industrial areas. Many rivers, however, have improved from their worst state in the 1960s. There are currently 133 active, 17 proposed, and 44 deleted EPA Superfund National Priority List sites in this ecoregion.

The approximate population of this ecoregion is 38,399,000, about 13% of the population of the United States.

Summary of WSA Findings

A total of 132 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales.

In a series of WSA regional workshops to evaluate the WSA results, professional biologists expressed the view that it is hard to find high quality reference sites because even the least-disturbed streams in the Temperate Plains are influenced by a long history of land use. Extensive agriculture and development have influenced virtually all waterbodies in this region. An overview of the WSA survey results for the Temperate Plains ecoregion is shown in Figure 3-6.

Biological Condition

- The Macroinvertebrate Index reveals that 37% of stream length in the Temperate Plains ecoregion is in poor condition compared to reference, 37% is in fair condition, and 26% is in good condition compared to least-disturbed reference condition.
- The O/E taxa loss indicator tells us that 40% of stream miles have lost 10% or more of the macroinvertebrate taxa that are expected to occur, and 11% have lost 50% of taxa. This indicator reports that 58% of stream miles have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference conditions.

Indicators of Stress

Leading indicators of stress in the Temperate Plains ecoregion include total nitrogen, riparian disturbance, in-stream fish habitat, and riparian vegetative cover.

- About 12% of the stream miles have high levels of phosphorus and 13% have medium levels compared to this region's least-disturbed reference conditions. The remaining 74% have low levels.
- About 41% of the stream miles have high levels of nitrogen, 17% have medium levels, and 41% have low levels compared to thresholds based on the region's reference conditions.
- About 38% of the stream miles in this region have high levels of riparian disturbance, and the majority, 58%, have intermediate levels of disturbance in the riparian zone. Only 3% of the stream miles in the Temperate Plains have low levels of human influence in the riparian zone.
- Salinity is present at high levels in 2% of streams miles and at medium levels in 13%.
- Excess streambed sediments affect streams in this ecoregion to a lesser extent than the other physical stressors. Streambed sediments are rated in poor condition in 20% of stream miles, in fair condition in 12%, and in good condition in the remaining 67% of stream length.
- In-stream fish habitat is in poor condition in 39% of stream miles, in fair condition in 19%, and in good condition in 41%.
- About 26% of the stream length has poor riparian vegetative cover, 17% has fair or intermediate cover, and the remaining 53% has good cover.
- The effects of acidification are not noted in this region.

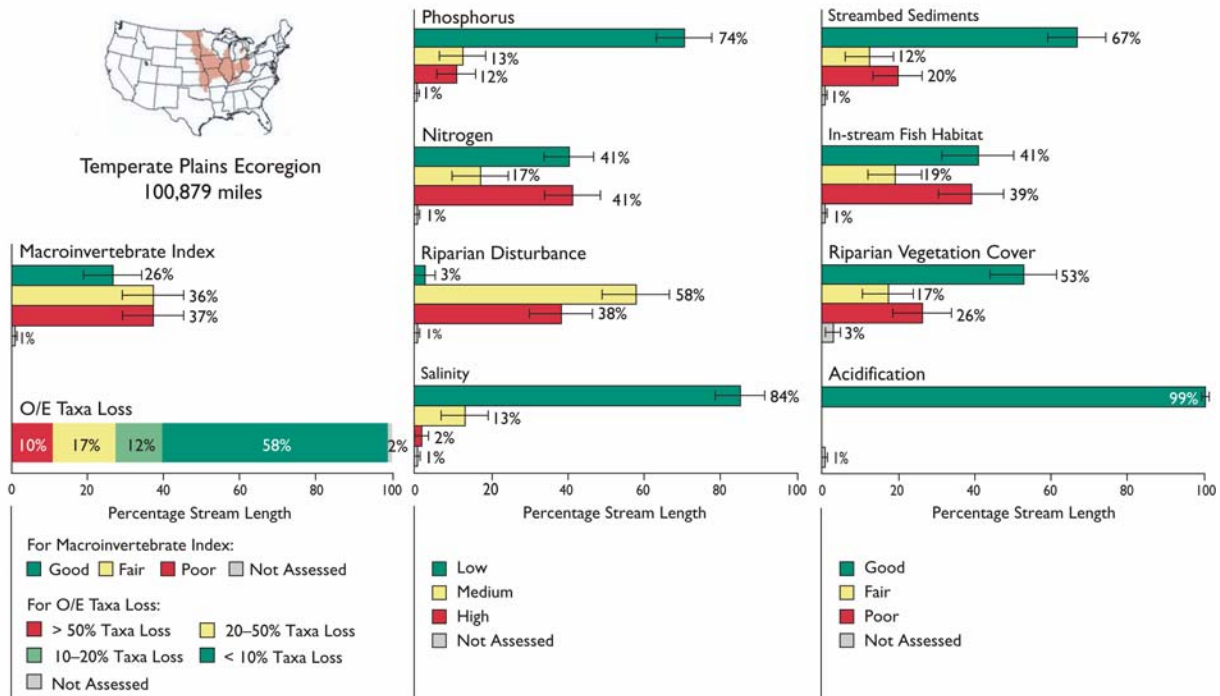


Figure 3-6. WSA survey results for the Temperate Plains ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Southern Plains Ecoregion

Physical Setting

The Southern Plains ecoregion covers approximately 405,000 (13.5% of the United States) and includes central and northern Texas; most of western Kansas and Oklahoma; and portions of Nebraska, Colorado, and New Mexico. The terrain is a mix of smooth and irregular plains interspersed with tablelands and low hills. The Arkansas, Platte, White, Red and Rio Grande rivers flow through this region, and most of the great Ogallala aquifer lies underneath this region. A total of 19,263 wadeable stream miles in the Southern Plains ecoregion are represented in the WSA.

Most of the land use is arable and arable with grazing, with desert or semi-arid grazing land in the south. Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 45% grassland, 32% planted/cultivated, and 14% shrubland, with the remaining 9% of land in other types of cover. Federal land ownership in the region totals about 11,980 mi² or approximately 3% of the total, the lowest share of all WSA aggregate ecoregions. The climate is dry temperate, with mean annual temperature in the 45° to 79° F range. Annual precipitation for the region is between 10 and 30 inches.

Biological Setting

Vegetative cover in the north is mainly short prairie grasses such as buffalo grass, while in the south, grasslands with mesquite, juniper, and oak are common. Coastal vegetation is typically more salt-tolerant in nature.

Human Influence

The Great Prairie grasslands, which once covered much of the Southern Plains region, are the most altered and endangered large ecosystem in the United States. About 90% of the original tall grass prairie was replaced by other vegetation or land use. Agriculture is an important economic activity in this region and includes sorghum, wheat, corn, sunflower, bean, and cotton production. Livestock production and processing is prevalent, especially goats, sheep, and cattle. The region contains a sizable portion of U.S. petroleum and natural gas production in Oklahoma, Kansas, and Texas. Electricity in this ecoregion is generated almost exclusively with gas-fired power plants. Some uranium and zinc mining is found in Oklahoma and the Texas panhandle. There are currently 39 active, 5 proposed, and 14 deleted EPA Superfund National Priority List sites in this ecoregion.

The approximate population in this ecoregion is 18,222,000, which is 6% of the population of the United States.

Summary of WSA Findings

A total of 49 random sites were sampled during the summer of 2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales.

At a series of regional workshops to evaluate results professional biologists expressed the view that no undisturbed streams remain in the Southern Plains region. The least-disturbed streams are those that retain natural configuration and have riparian buffer zones. An overview of the WSA survey results for the Southern Plains ecoregion is shown in Figure 3-7.

Biological Condition

- The Macroinvertebrate Index reveals that 54% of stream length in the Southern Plains ecoregion is in poor condition, 20% is in fair condition, and 22% is in good condition compared to least-disturbed reference condition. There is no data for the remaining 4% of stream length.
- The O/E taxa loss indicator tells us that 50% of streams have lost 10% or more of the macroinvertebrate taxa expected to occur, and 15% have lost 50% of taxa. This indicator reports that 42% of the stream miles have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

Indicators of Stress

The most widespread indicators of stress in the Southern Plains ecoregion include total phosphorus, total nitrogen, in-stream fish habitat, and riparian vegetative cover.

- Phosphorus is found at high levels in 48% of the stream length, at medium levels in 7%, and at low levels in 45% of stream miles compared to thresholds based on least-disturbed reference condition.
- Nitrogen is high in 36% of stream miles, medium in 30%, and low in the remaining 34%.
- Riparian disturbance is rated as high in 19% of stream miles in this ecoregion. The majority of stream miles, 67%, are rated as medium, and only 14% are rated low for evidence of human influence in the riparian zone.
- Salinity is found at high levels in 22% of stream miles, at medium levels in 21%, and at low levels in 57%.
- About 30% of stream miles are rated in poor condition for excess streambed sediments. Streambed sediments are fair in 18% of stream miles and good in 52% of stream miles.
- About 42% of the stream resource has poor in-stream fish habitat and 23% has a fair rating; 35% is in good condition.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 36% of the stream length, in fair condition for 40%, and good condition for 24% of stream length.
- The effects of acidification are not noted in the Southern Plains region.

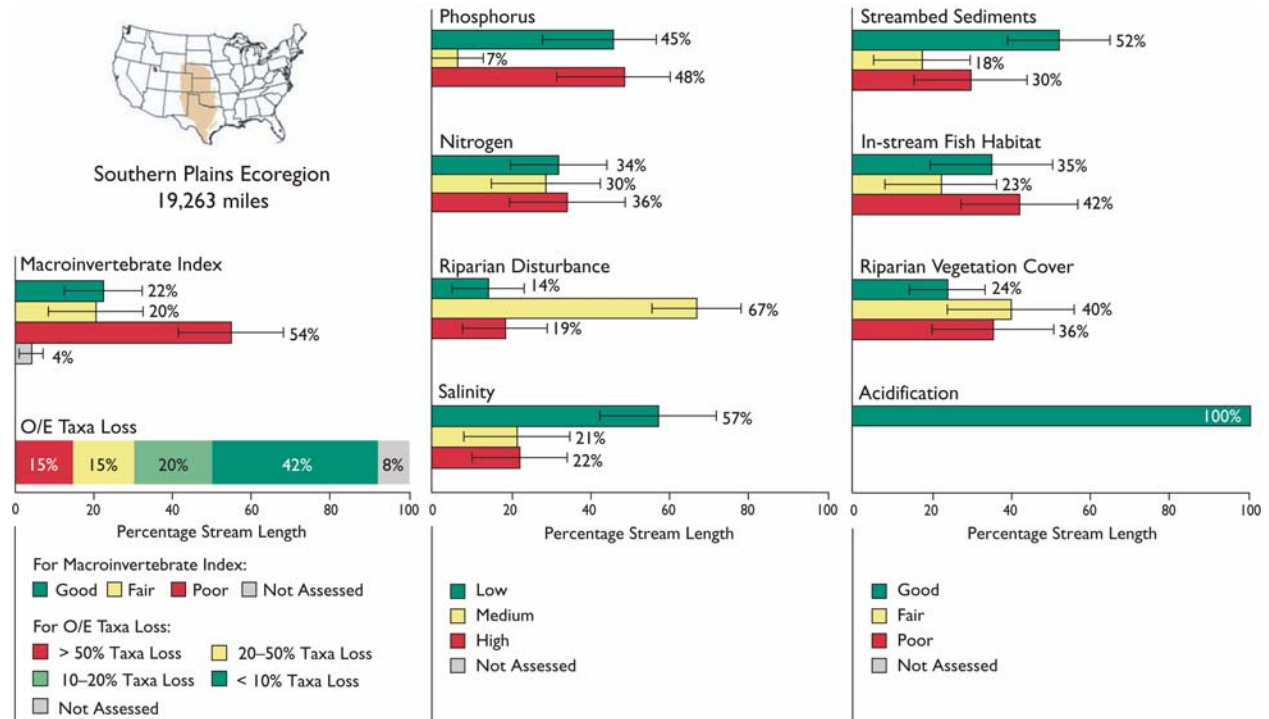


Figure 3-7. WSA survey results for the Southern Plains ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Northern Plains Ecoregion

Physical Setting

The Northern Plains ecoregion covers approximately 205,084 mi² (6.8% of the United States), including the western Dakotas, Montana east of the Rocky Mountains, northeast Wyoming, and a small section of northern Nebraska. Federal lands account for 52,660 mi² or a relatively large 25.7% share of the total area. The Great Prairie grasslands were also an important feature of this region, but about 90% of these grasslands have been replaced by other vegetation or land use. Terrain of the area is irregular plains interspersed with tablelands and low hills. This ecoregion is the heart of the Missouri River system and is almost exclusively within the Missouri River's regional watershed. A total of 13,445 Wadeable Stream miles in the Northern Plains ecoregion are represented in the WSA.

Land use is arable with grazing or semi-arid grazing. Based on satellite images in the 1992 National Land Cover Dataset, the the distribution of land cover is 56% grassland and 30% planted/cultivated, with the remaining 14% of land in other types of cover. Significant wetlands are also found in the Nebraska Sandhills area. The climate is dry and continental, characterized by short, hot summers and long, cold winters. Temperatures average 36° to 46° F, and annual precipitation totals range from 10 to 25 inches. High winds are an important climatic factor in this ecological region. It is also subject to periodic, intense droughts and frosts.

Biological Setting

The predominant vegetative cover for the Northern Plains ecoregion was formerly native short prairie grasses such as wheat grass and porcupine grass, but now cropland is much more prevalent.

Human Influence

Human economic activity is primarily agriculture, including cattle and sheep grazing, as well as the growing of wheat, barley, and sugar beets. Coal mining occurs in the North Dakota, Montana, and Wyoming portions of the region. Petroleum and gas production has grown considerably in the Cut Bank region in north central Montana. There are several large Indian reservations in this region, including the Pine Ridge, Standing Rock, and Cheyenne reservations in South Dakota and the Blackfeet, Crow, and Fort Peck reservations in Montana. There are currently four active and one proposed EPA Superfund National Priority List sites in this ecoregion.

The approximate population of this ecoregion is relatively small at 1,066,000, or 0.4% of the population of the United States.

Summary of WSA Findings

A total of 98 random sites were sampled during the summers of 2000–2004 to characterize the condition of Wadeable Streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales.

In a series of regional workshops, professional biologists expressed the view that while there are relatively few undisturbed streams in the Northern Plains ecoregion, the majority are in

areas of low-level agriculture and pasture. An overview of the WSA survey results for the Northern Plains ecoregion is shown in Figure 3-8.

Biological Condition

- The Macroinvertebrate Index reveals that 50% of stream length in the Northern Plains ecoregion is in poor condition, 13% is in fair condition, and 30% is in good condition compared to least-disturbed reference condition for the ecoregion. There is no data for the remaining 7% of stream length.
- The O/E taxa loss indicator tells us that 34% of stream miles have lost 10% or more of the macroinvertebrate taxa expected to occur, and 12% have lost 50% of their taxa. This indicator reports that 60% of stream miles have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

Indicators of Stress

The most widespread indicators of stress in the Northern Plains ecoregion include riparian vegetative cover, in-stream fish habitat, riparian disturbance, and salinity.

- Phosphorus is high in 33% of stream miles and medium in 13%. The remaining 54% of streams have low phosphorus levels compared to thresholds based on least-disturbed reference condition for the ecoregion.
- Nitrogen is high in 18% of stream miles and medium in 21%. It is found in low levels in 60% of stream miles.
- Riparian disturbance is high in 31% of stream length and medium in 66%. This evidence of human influence in the riparian zone is low for 3% of stream miles.
- Salinity is a significant stressor in the Northern Plains. Salinity is high in 38% of stream miles, medium in 22%, and low in 40% compared to reference-based thresholds.
- In this ecoregion, 33% of stream miles are rated poor for excess streambed sediments, 14% are rated fair, and 50% are rated good. There is no sediments data for 2% of stream length in this region.
- In-stream fish habitat is poor in 45% of streams, fair in 21%, and good in 34%.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 50% of stream miles, in fair condition for 22% of stream miles, and in good condition for 28% of stream miles.
- As with several other ecoregions, the effects of acidification are not noted in the Northern Plains.



Figure 3-8. WSA survey results for the Northern Plains ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Western Mountains Ecoregion

Physical Setting

The Western Mountain ecoregion includes the Cascade, Sierra Nevada, Pacific Coast ranges in the coastal states, the Gila Mountains in the south western states, and the Bitterroot and Rocky Mountains in the northern and central mountain states. This region covers approximately 397,832 mi², with about 297,900 mi² or 74.8% classified as federal land — the highest proportion of federal property among all the 9 aggregate ecoregions. The terrain of this area is characterized by extensive mountains and plateaus separated by wide valleys and lowlands. Coastal mountains are cut through by numerous fjords and glacial valleys, bordered by coastal plains, and include important estuaries along the ocean margin. Soils are mainly nutrient-poor forest soils. Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 59% forested, 19% shrubland, and 13% grassland, with the remaining 9% of land in other types of cover.

The headwaters and upper reaches of the Columbia, Sacramento, Missouri, and Colorado river systems all occur in this region. Smaller rivers share the characteristic of steep mountain streams, starting as steep staircase-like channels with steps and plunge pools, and with pools and riffles appearing as slope decreases. Upper river reaches experience debris flows and landslides over shallow soils, which are saturated by rainfall or snowmelt. A total of 126,436 miles of wadeable streams in the Western Mountains ecoregion are represented in the WSA.

The climate is sub-arid to arid and mild in southern lower valleys, and humid and cold at higher elevations. The wettest climates of North America occur in the marine coastal rain forests of this region. Mean annual temperatures are in the 32° to 55° F range, and annual precipitation ranges from 16 to 240 inches.

Biological Setting

Rivers in this ecoregion drain dense forested catchments and contain a lot of wood that provides habitat diversity and stability. Rivers reaching the Pacific Ocean historically had large runs of salmon and trout, including pink, chum, sockeye, coho and chinook salmon, and cutthroat and steelhead trout. Many of these anadromous fish populations have been reduced since the time of European settlement due to the effects of overfishing, introduced species, flow regulations, and dams. Spawning habitats in stream pools have been drastically reduced due to increased sediments from logging, mining, and other land use changes.

Human Influence

Deforestation and urbanization continue to alter stream habitats in the mountainous west. The Western Mountain riparian ecosystems first encountered pressure from grazing and mining from the mid 1800s to about 1910, and then from the logging roads and fire management that occur to the present day.

Placer mining, which disrupts stream sediment habitats, was once widespread in the Western Mountains. Particularly damaging in mountainous areas was the introduction of mercury, which was used extensively in placer mining for gold. Toxic contaminants from mining also include arsenic, antimony, copper, chromium, cadmium, nickel, lead, selenium, silver, and zinc. In addition to mining, logging, grazing, channelization, dams, and diversions in the Sierra Nevada area also significantly impacted rivers and streams. Introduced fish provided further stress, with several native fish species threatened or endangered.

The principal economic activities in this ecoregion are high-tech manufacturing, wood processing, international shipping, U.S. naval operations, commercial fishing, tourism, grazing, and timber harvesting. Hydroelectric power generation is prevalent in the Pacific Northwest area and California. Bauxite mining also occurs in the Pacific Northwest portions of the region. There are currently 74 active, 7 proposed, and 22 deleted EPA Superfund National Priority List sites in this ecoregion.

The approximate population in the Western Mountain ecoregion is 9,742,192, or about 3% of the population of the United States.

Summary of WSA Findings

A total of 529 random sites were sampled during the summers of 2000–2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales.

In a series of regional workshops, professional biologists expressed the view that many least-disturbed streams in the Western Mountain ecoregion are of relatively high quality; however, a certain percentage of these streams have mining and logging impacts, leading to

reference conditions of varying degrees of quality. An overview of the WSA survey results for the Western Mountains ecoregion is shown in Figure 3-9.

Ecological Condition

- The Macroinvertebrate Index reveals that 25% of stream length in the Western Mountains ecoregion is in poor condition, 28% is in fair condition, and 46% is in good condition compared to least-disturbed reference condition. There is no data for about 1% of stream length.
- The O/E taxa loss indicator tells us that 33% of streams have lost 10% or more of the macroinvertebrate taxa expected to occur, and 5% have lost 50% of taxa. This indicator tells us 63% have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

Indicators of Stress

The most widespread indicators of stress in the Western Mountains ecoregion include total nitrogen, total phosphorus, riparian disturbance, and streambed sediments.

- Phosphorus is rated as high in 16% of stream length, medium in 25%, and low in 59%.
- Nitrogen is found at high levels in 17% of streams, at medium levels in 28%, and at low levels in 54% relative to the least-disturbed reference condition.
- Riparian disturbance is at high levels in 14% of stream miles and at medium levels in 47%. This evidence of human influence in the riparian zone is low for 39% of stream miles.
- Salinity is found at low levels in about 3% of streams in the region.
- In this ecoregion, 14% of stream miles are rated poor for excess streambed sediments, 22% of streams are rated in fair condition; the remaining 63% are in good condition.
- In-stream fish habitat is in poor condition in 9% of stream miles. Another 20% are rated as fair, and 70% are rated good for this indicator.
- Vegetative cover in the riparian zone along stream banks is in poor condition for 9% of stream miles, fair for 32% of stream miles, and good for 59% of stream miles.
- The effects of acidification are not noted in this region.



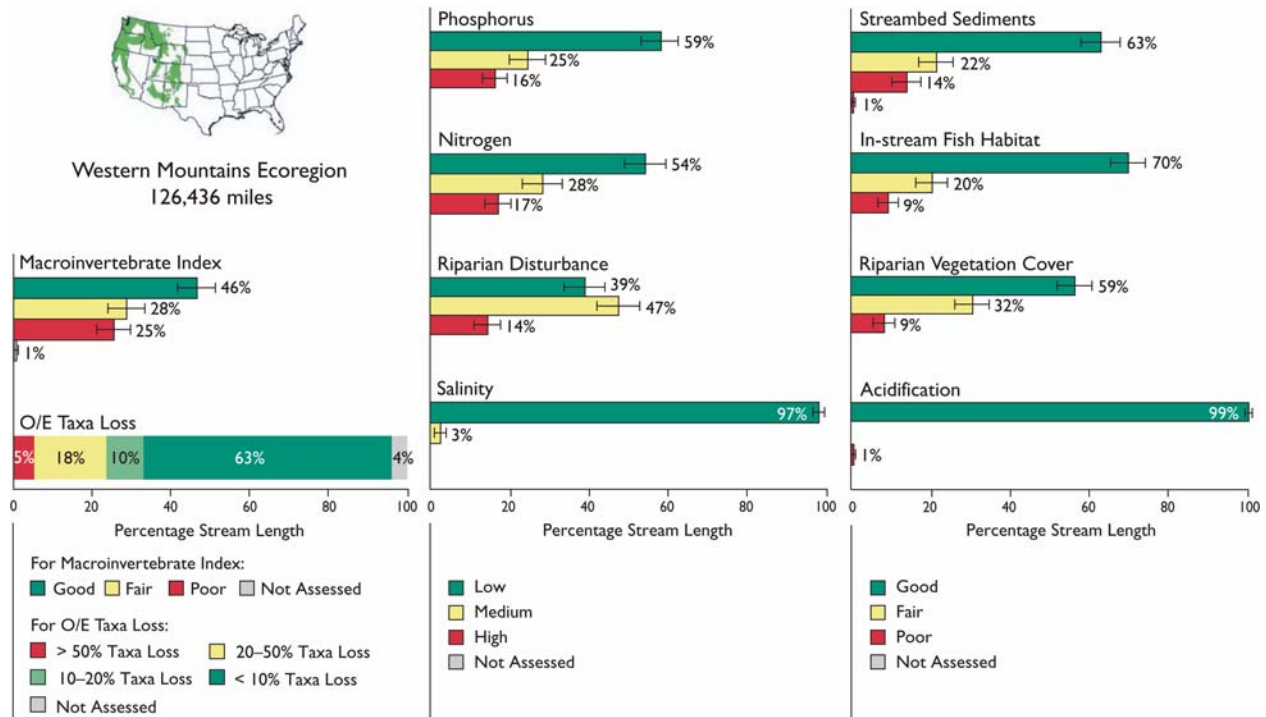


Figure 3-9. WSA survey results for the Western Mountains ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.

Xeric Ecoregion

Physical Setting

The Xeric ecoregion covers the largest area of all WSA aggregate ecoregions and the most total land under federal ownership. This ecoregion covers portions of eleven western states and all of Nevada for a total of about 636,583 mi² (21.2% of the United States). Some 453,000 mi² or 71.2% of the land is classified as federal lands, including large tracts of public land such as the Grand Canyon National Park, Big Bend National Park, and the Hanford Nuclear Reservation. Tribal lands include the Navajo, Hopi, and Yakima reservations. Based on satellite images in the 1992 National Land Cover Dataset, the distribution of land cover is 61% shrubland and 15% grassland, with the remaining 24% of land in other types of cover.

The Xeric ecoregion is comprised of a mix of physiographic features, including plains with hills and low mountains, high-relief tablelands, piedmont, high mountains, and intermountain basins and valleys. The region includes the flat to rolling topography of the Columbia/Snake River Plateau; the Great Basin; Death Valley; and the canyons, cliffs, buttes, and mesas of the Colorado Plateau. All of the non-mountainous area of California falls in the Xeric ecoregion and is distinguished by a mild Mediterranean climate, agriculturally productive valleys, and large metropolitan areas.

This region's relatively limited surface water supply contributes to the Upper and Lower Colorado, Great Basin, California, Rio Grande, and Pacific Northwest regional watersheds.

Large rivers flow all year and are supplied by snowmelt and peak in early summer. Small rivers in this ecoregion are mostly ephemeral. Most rivers are turbid because they drain erodible sedimentary rock in a dry climate, where sudden rains flush sediments down small rivers. Rivers are often subject to rapid change due to flash floods and debris flows. In southern areas, dry conditions and water withdrawals produce internal drainages that end in saline lakes or desert basins without reaching the ocean (e.g., Utah's Great Salt Lake). A total of 25,989 miles of wadeable streams in the Xeric ecoregion are represented in the WSA.

The Xeric region's climate varies widely from warm and dry to temperate, with mean annual temperatures ranging from 32° to 75° F and annual precipitation in the 2 to 40 inch range. The dry weather in the Sonoran, Mojave, and Chihuahuan deserts is created by the rain shadows cast by the mountains to the west and is punctuated by heavy, isolated episodic rainfalls.

Biological Setting

Rivers create a riparian habitat oasis for plants and animals in the dry Xeric ecoregion areas. Many fishes are endemic and restricted to the Colorado River basin and have evolved to cope with warm, turbid waters. Examples include the humpback chub, bonytail chub, Colorado pikeminnow, roundtail chub, razorback sucker, Colorado squawfish, Pyramid Lake cui-ui, and Lahontan cutthroat trout. Most of these fishes are threatened or endangered as a result of flow regulations from dams, water withdrawals, and introduced non-native species. Endangered species of fish in desert areas include the Sonora chub and beautiful shiner.

Human Influence

Impacts to the Xeric ecoregion riparian habitats have been heavy in past 250 years because of water impoundment and diversion; groundwater and surface water extraction; grazing and agriculture; and mining, road development, and heavy recreational demand. Both the least-altered and most-altered pre-settlement natural vegetation types are found in this region. Riparian habitats in this region have also been widely impacted by invasive species and contamination from agriculture and urban runoff. Big rivers in the southwestern canyon regions were altered due to large dam construction and large-scale water removal projects for cities and agriculture, with attendant small streams that experience cycles of draining and filling in response to grazing, groundwater withdrawal, and urbanization. In many desert areas, dissolved solids such as boron, molybdenum, and organophosphates leach from desert soils into irrigation waters. Almost every tributary in California's Central Valley has been altered by canals, drains, and other waterways.

Principal economic activities include recreation and tourism; mining, agriculture, and grazing; manufacturing and service industries; agriculture and food processing; aerospace and defense industries; and automotive-related industries. Petroleum production is prevalent in California. Agriculture includes production of a wide range of crops, from wheat, dry peas, lentils, and potatoes, to grapes and cotton. Large agricultural irrigation projects include the Salt and Gila valleys and the Imperial and Central valleys in California. There are currently 139 active, 6 proposed, and 24 deleted EPA Superfund National Priority List sites in this ecoregion.

The total population in the Xeric ecoregion is the third largest of all WSA ecoregions at approximately 46,800,000 people, or 16% of the population of the United States.

Summary of WSA Findings

A total of 176 random sites were sampled during the summers of 2000–2004 to characterize the condition of wadeable streams throughout the ecoregion. The regional results may not be extrapolated to an individual state or stream within the region because the study design was not intended to characterize stream conditions at these finer scales.

In a series of regional workshops to evaluate the results, professional biologists expressed the view that many of the perennial, least-disturbed streams in this region have been influenced by past and current human activities. An overview of the WSA survey results for the Xeric ecoregion is shown in Figure 3-10.

Biological Condition

- The Macroinvertebrate Index reveals that 39% of stream length in the Xeric ecoregion is in poor condition compared to least-disturbed reference, 15% is in fair condition, and 42% is in good condition. There is no data for about 4% of stream length.
- The O/E taxa loss indicator tells us that 61% of streams have lost 10% or more of the macroinvertebrate taxa expected to occur, and 15% have lost 50% of taxa. This indicator tells us 34% have retained 90% of the groups or classes of organisms expected to occur based on least-disturbed reference condition.

Indicators of Stress

The leading indicators of stress in the Xeric ecoregion include riparian disturbance, total nitrogen, streambed sediments, and in-stream fish habitat.

- Phosphorus is found at high levels in 29% of stream miles, at medium levels in 10% and at low levels in 60% of stream miles. About 1% of streams in this ecoregion have no data for phosphorus.
- Nitrogen is the leading chemical stressor in the Xeric region. It is found at high levels in 36% of stream miles, at medium levels in 26%, and at low levels in 37% of stream miles.
- Riparian disturbance is the leading physical stressor for the Xeric region. It is found at high levels in 44% of stream miles in this ecoregion and medium levels in 40%. The remaining 14% of stream miles have low levels evidence of human influence in the riparian zone.
- Salinity is rated high in 13% of stream miles and medium in 29%, with the remaining 56% rated as low. About 1% of stream miles have no data for salinity.
- In this ecoregion, 32% of stream miles are rated poor for excess streambed sediments, 17% are rated fair, and 48% of stream miles are rated in good condition. For 3% of streams, there is no data for sediments.
- In-stream fish habitat is poor in 27% of streams, fair in 25% of streams, and good in 47%. The remaining 1% of streams have no data on this stressor.

- Vegetative cover in the riparian zone along stream banks is in poor condition for 28% of streams, in fair condition for 21% of streams, and in good condition for 49% of streams of the Xeric region.
- As with a number of other ecoregions, the effects of acidification are not noted in the Xeric ecoregion.

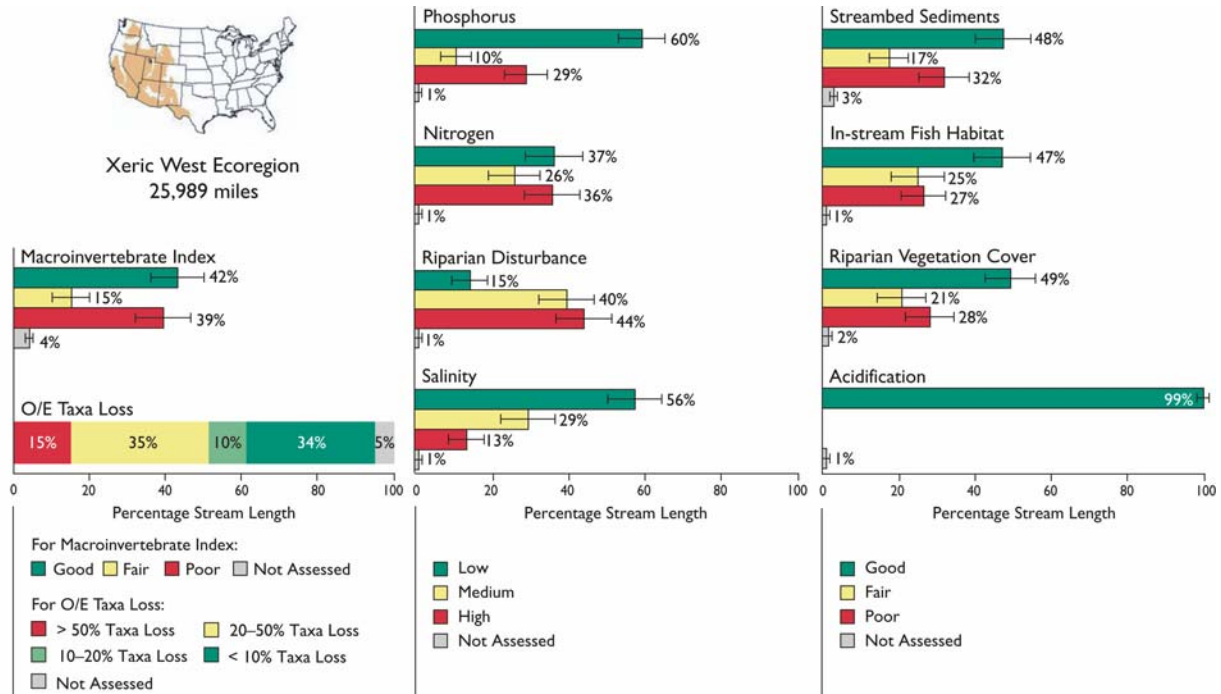


Figure 3-10. WSA survey results for the Xeric ecoregion.

Bars show the percentage of stream length within a condition class for a given indicator. Lines with brackets represent the width of the 95% confidence interval around the percent of stream length. Percents may not add up to 100 because of rounding.